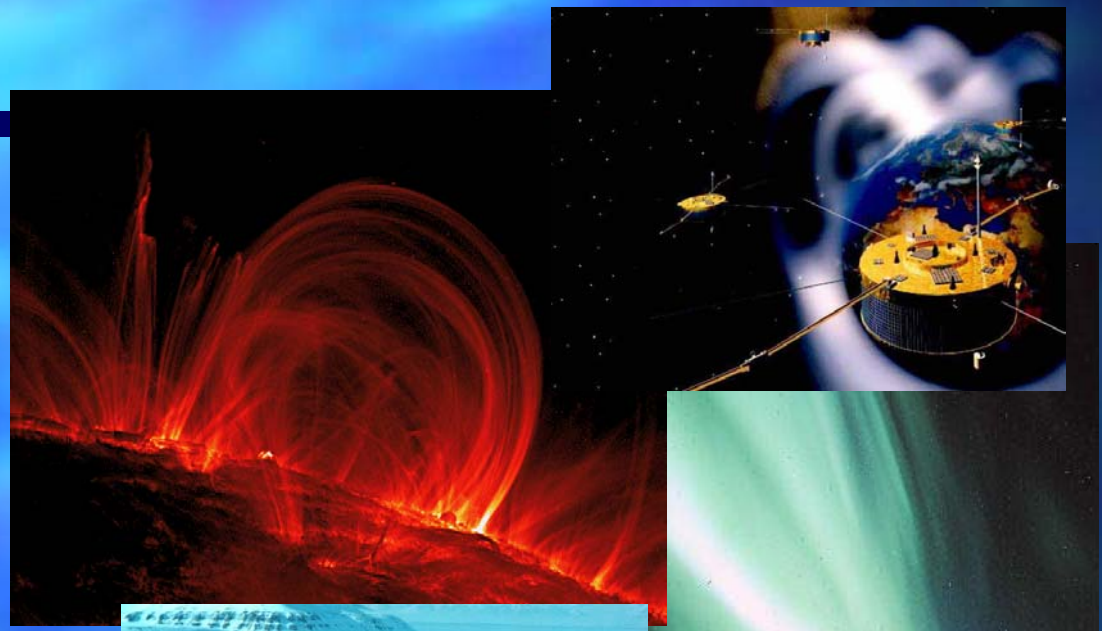
Potential ESA Contributions to International Living With a Star



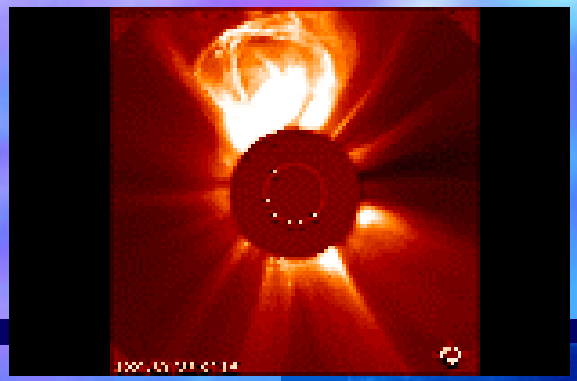
esa

International Living With a Star

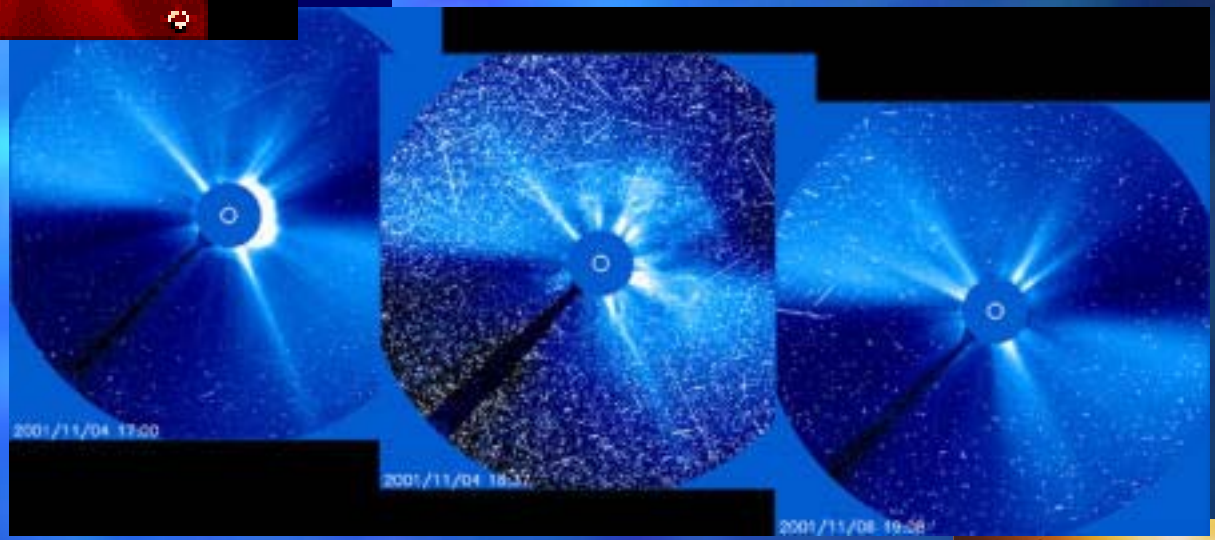
ILWS INTERNATIONAL LIVING WITH A STAR

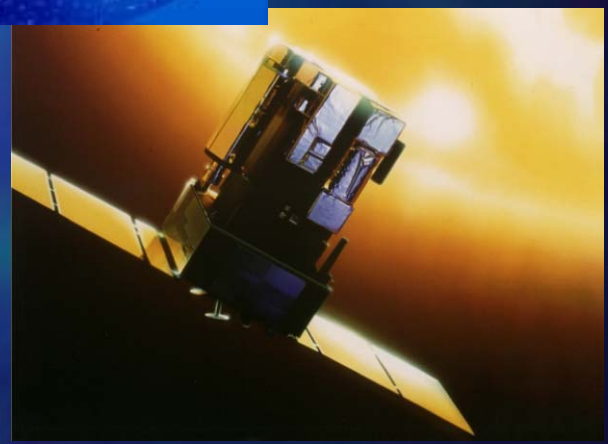
1. Solar and Heliospheric Physics

Potential ESA - ILWS Contributions



SOHO: ESA's Solar Cornerstone Mission

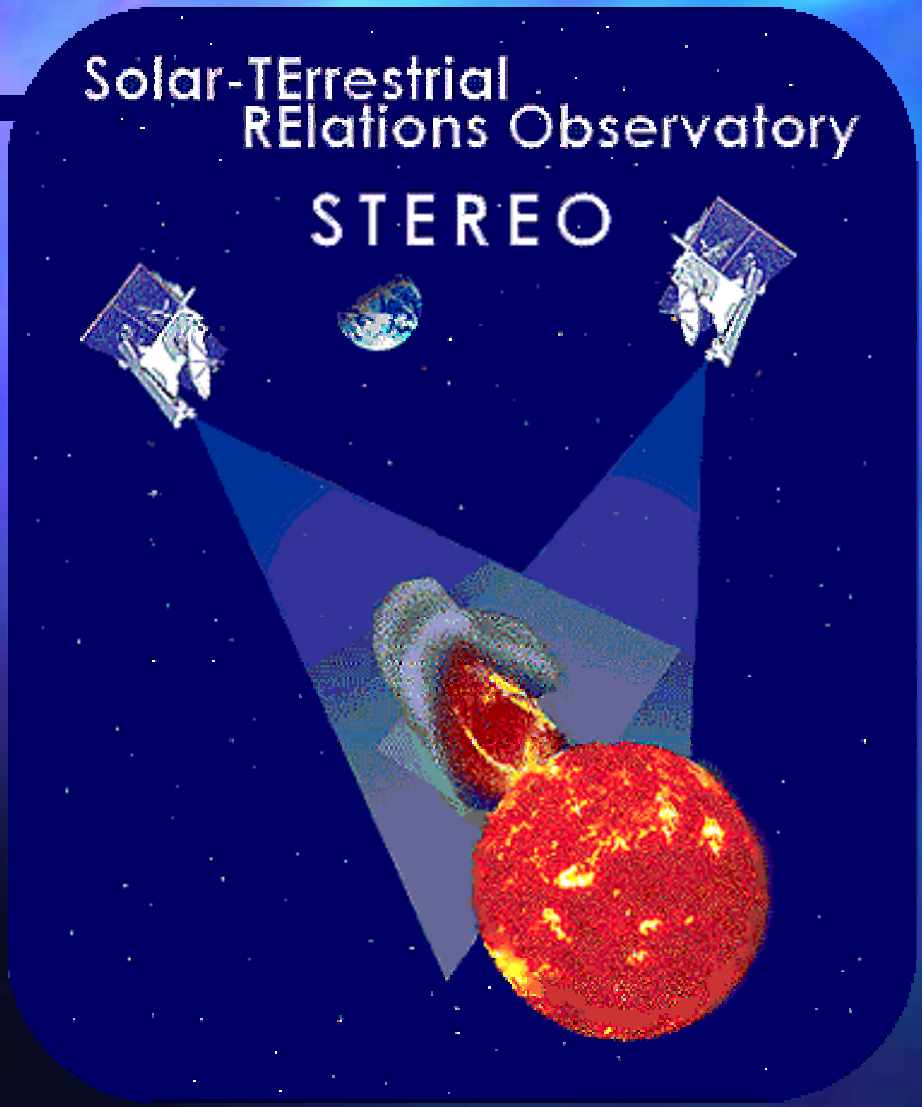




Solar Observation Satellite:
ESA / NASA Collaboration
4 year mission extension granted
2003-2007 (Pre-ILWS)

Next Japanese Solar Mission with NASA & UK Participation
(Ground Station Support from ESA agreed by SPC Jan.2003)
Launch late 2005 (2006?)

STEREO and SDO - Solar Dynamics Observatory



"Targets of Opportunity"

Both NASA missions Stereo and SDO contain a considerable European payload participation

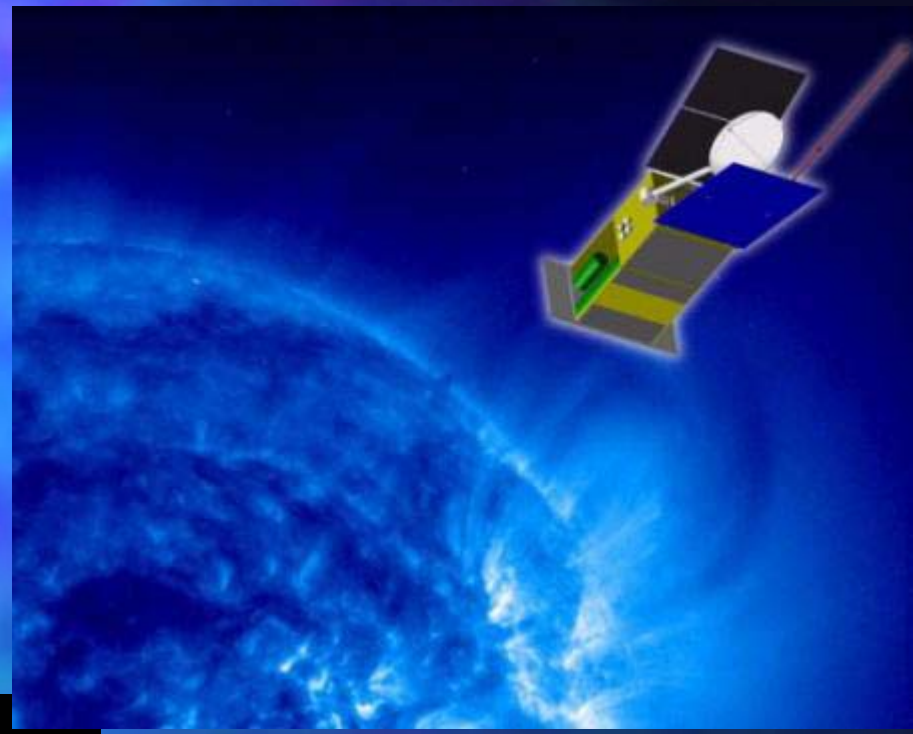
ESA considers to contribute to STEREO and/or SDO and to play a co-ordinating role in payload provision from Europe

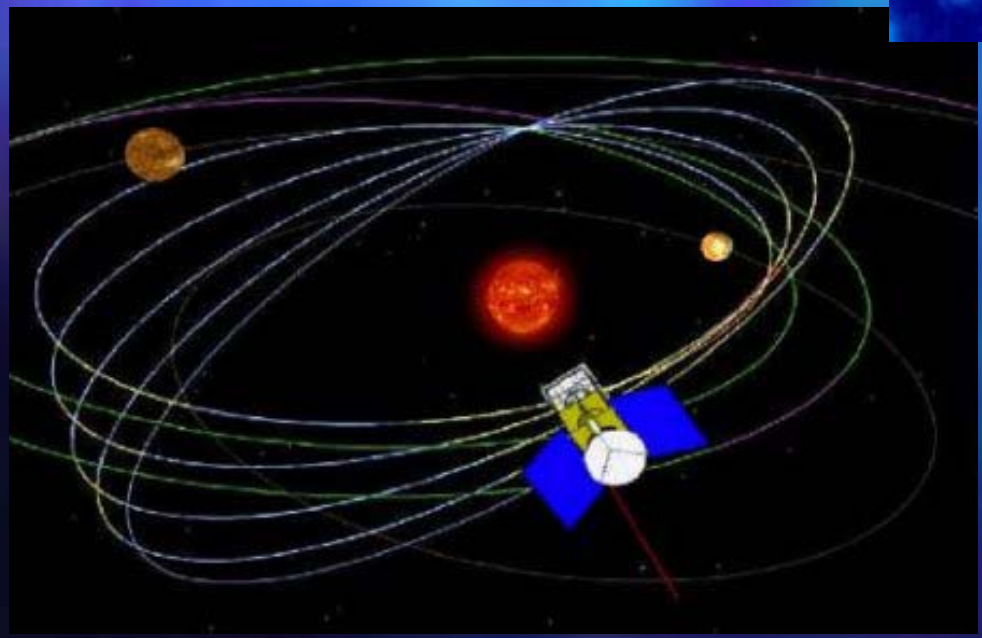
Launches: 2005 and 07

Solar Orbiter

ESA-ILWS Flagship in the long term

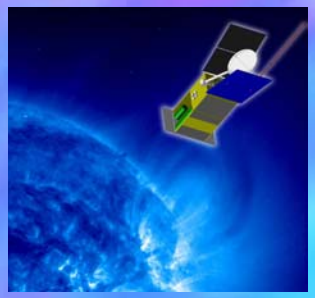
- Selected as ESA F-mission
- to be launched within the next 10 years
- lifetime 5 + 2 years
- NASA participation in Science and Payload Definition Teams





Inner Heliosphere in-situ and Solar Remote Sensing

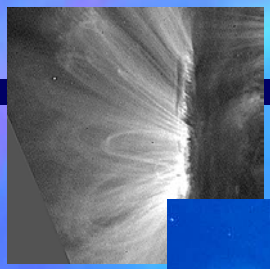
Orbit up to 38 deg out of the eccliptic plane, i.e. topside view of polar regions, CME's and the backside of the sun



Solar Orbiter: Mission Firsts

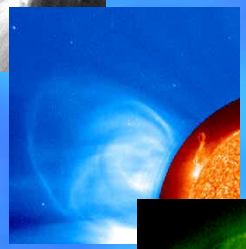
- explore the uncharted innermost regions of our Solar system
- study the Sun from close-up (45 solar radii or 0.21 AU)
- fly by the Sun tuned to its rotation and examine both the solar surface and the space above from a co-rotating vantage point
- provide images of the Sun's polar regions from heliographic latitudes as high as 38°

Planned Future International Solar Missions



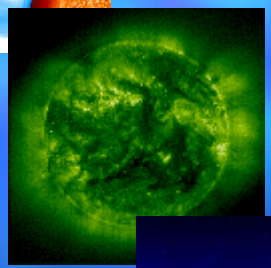
Solar-B [2005] – ISAS (+ NASA & ESA)

More Detail, Magnetic Field



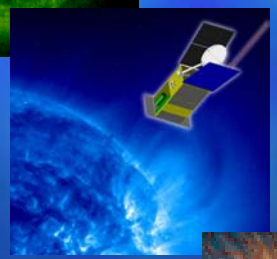
STEREO [2005] – NASA (+Europ. groups & ESA)

Out of Sun-Earth Line, 3-D, CMEs



Solar Dynamics Obs. [2007] – NASA (ESA?)

More Details, Helioseismology, CMEs



Solar Orbiter [2011+] – ESA (+NASA)

Out of Eccliptic, Far-Side, Co-Rotation,

Inner Heliosphere/Corona

Solar Probe - NASA

A Closer look

Sol. Sentinels – NASA (ESA-JPN SO/BC)

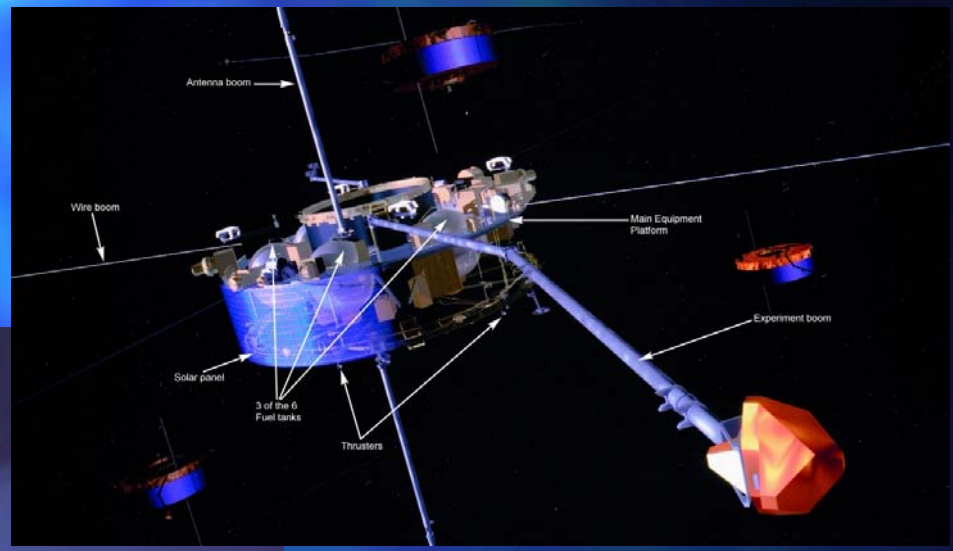
Multipoint Inner Heliosphere

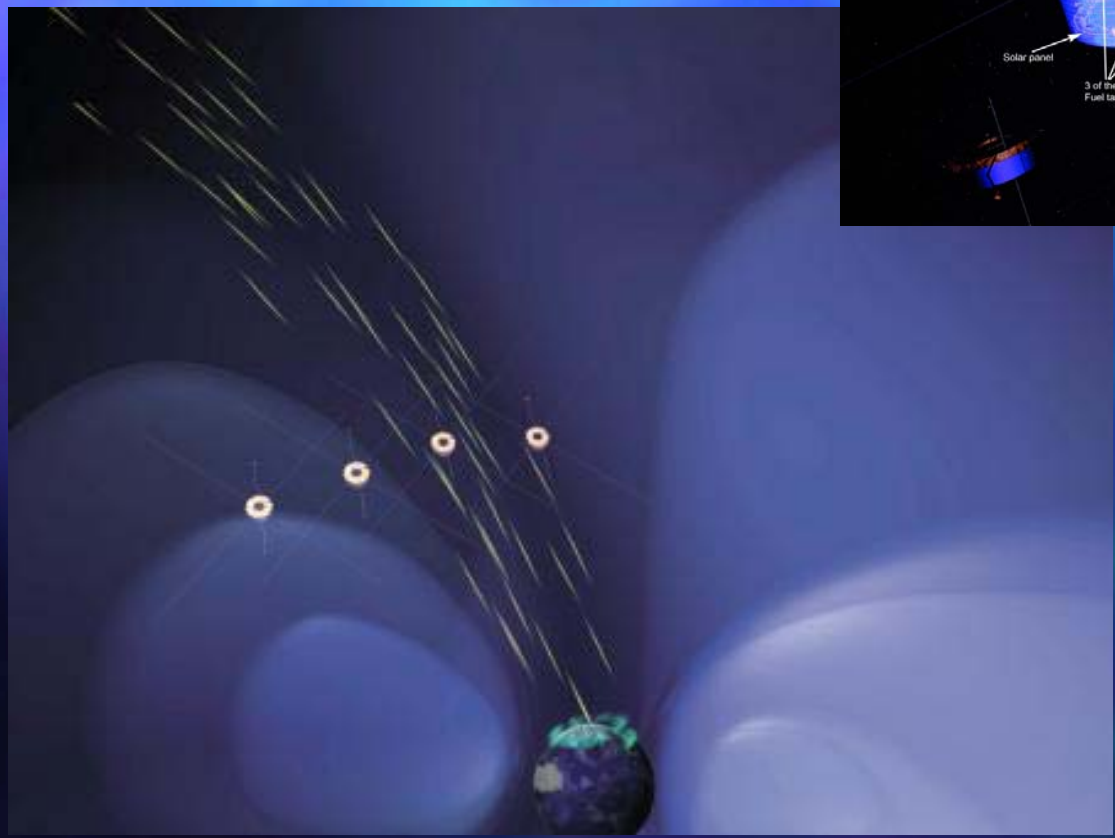
2. Magnetospheric / Ionospheric Physics - STP or SPP

Potential ESA - ILWS Contributions

Cluster

ESA's Magnetospheric Cornerstone Mission

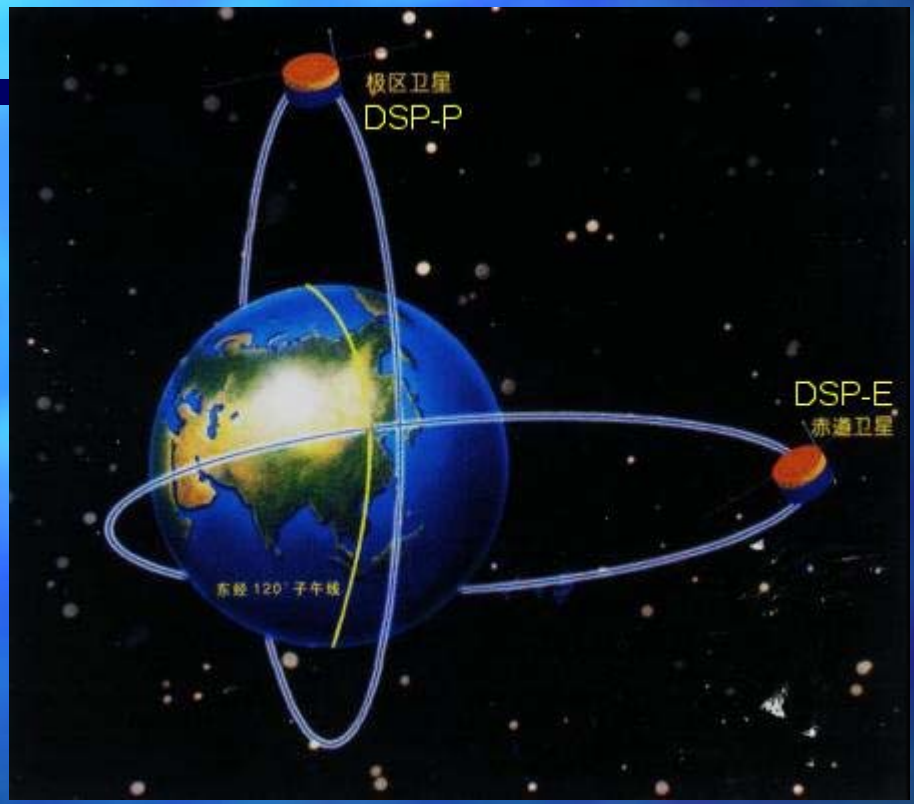




ESA-SPC decision made on 100 % orbital data coverage and 3 year mission extension 2003-2005 (Pre-ILWS)

DOUBLE STAR

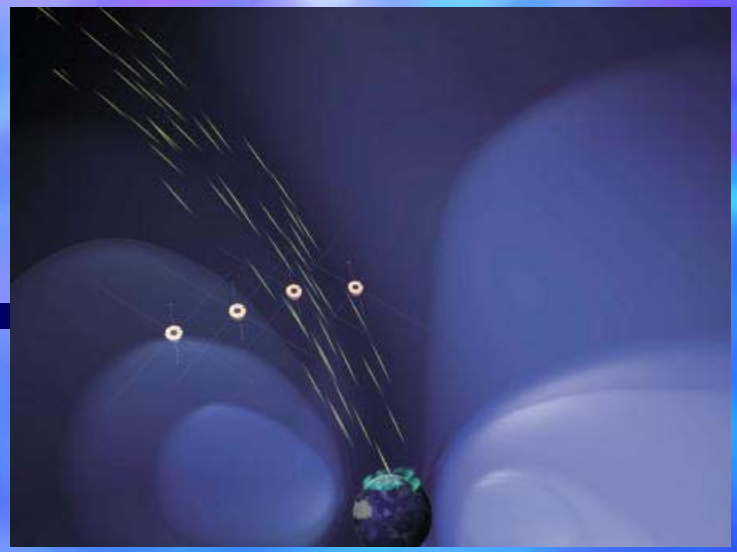
Chinese / ESA / European Collaboration



Two satellites equipped mainly with Cluster Spare Instruments in Magnetospheric Polar and Equatorial orbits

DSP –E: 550 km x 60000 km and DSP-P: 350 km x 25000 km

Launches in 2003 and 2004, resp. (Pre-ILWS)



CLUSTER Active Archive Phase

Recent ESA-D/Sci initiative to establish a public-domain high-resolution data archive for the CLUSTER mission, including value-added multi-instrument satellite and G-B data.

Proposal accepted by ESA SPC in January 2003 (6.8 M€)
Management plan prepared at ESTEC at this moment.

Ramping Built-up Phase 2003-2004, Operation 2005-2007
New staff at ESA/ESTEC as well as in European Pi-Teams

Why Do Science?

For Understanding \ For Utility	No	Yes
Yes	Bohr	Pasteur
No		Edison

From Donald Stokes (Woodrow Wilson School for Public and International Affairs, Princeton University)

The Sun-Earth Connection -- Science in the Pasteur Mode

- ***How a star works***
- ***How it affects humanity's home***
- ***How to live with a star***

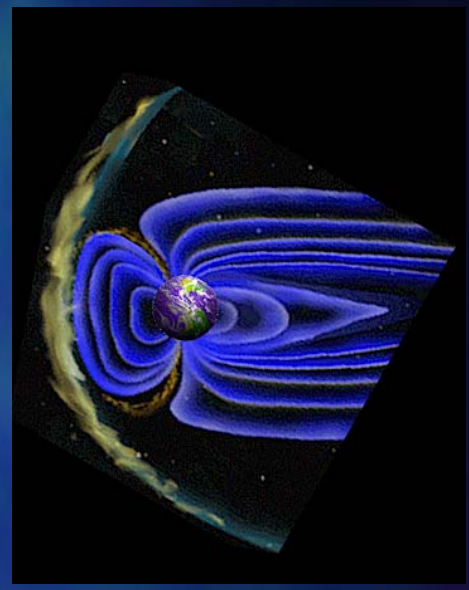
The Sun-Earth Connected System

Variable Star

Varying

- Radiation
- Solar Wind
- Energetic Particles

Planet



Questions:

- *How and why does the Sun vary?*
- *How does the Earth respond (and vary)?*
- *What are the impacts on humanity?*

Main Themes of ILWS:

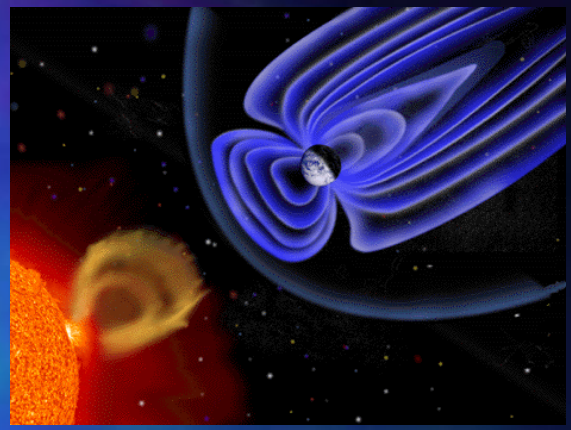
... to understand the governing processes of the connected Sun-Earth system...

... as an integrated entity.

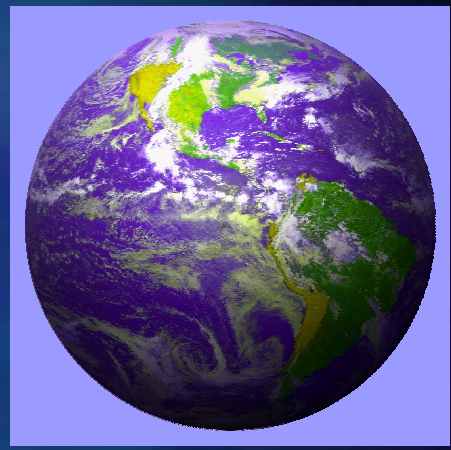
➔ simultaneous and coordinated observations

➔ at strategic locations in the entire system

Why Do We Care?



- **Solar Variability Affects Human Technology, Humans in Space, and the Terrestrial Climate.**
- **The Sphere of the Human Environment Continues to Expand Above and Beyond Our Planet.**



- Increasing dependence on space-based systems

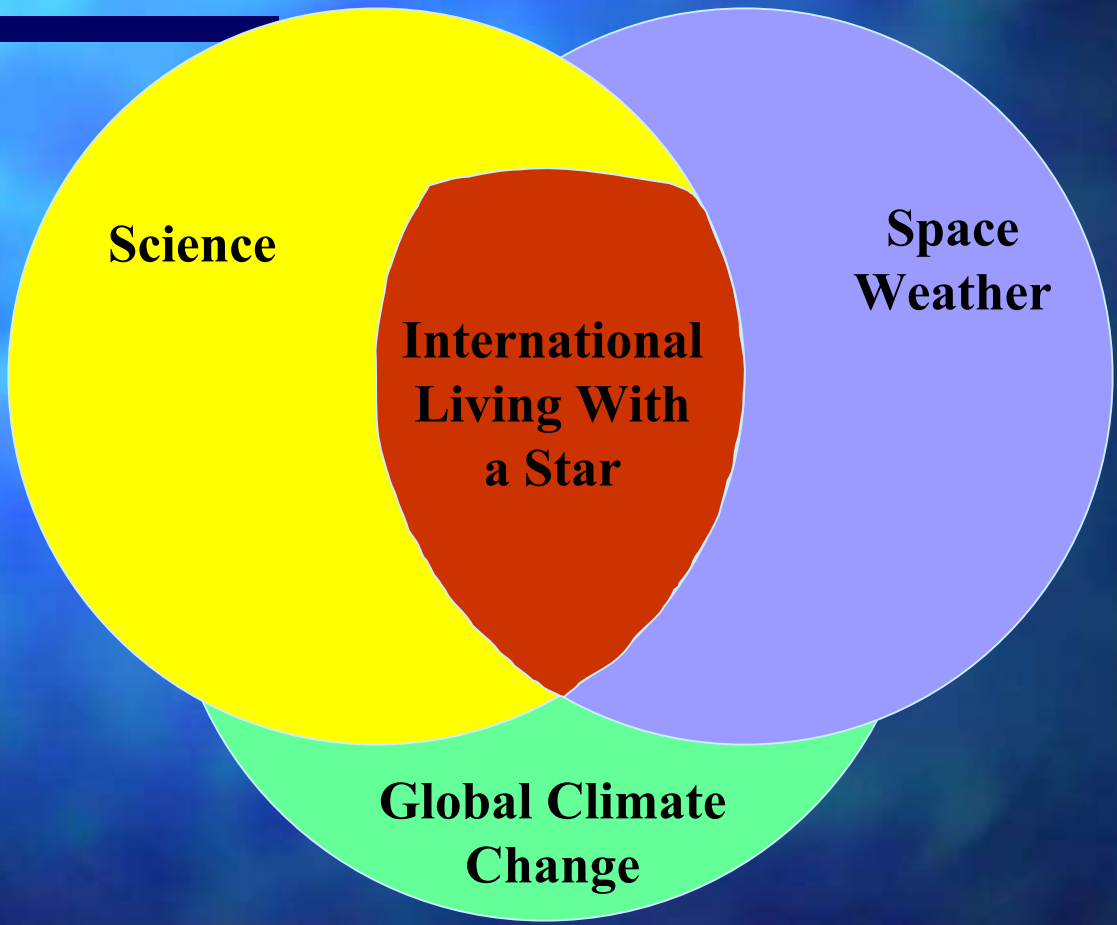
- Permanent presence of humans in Earth orbit and beyond

What can we do about it?

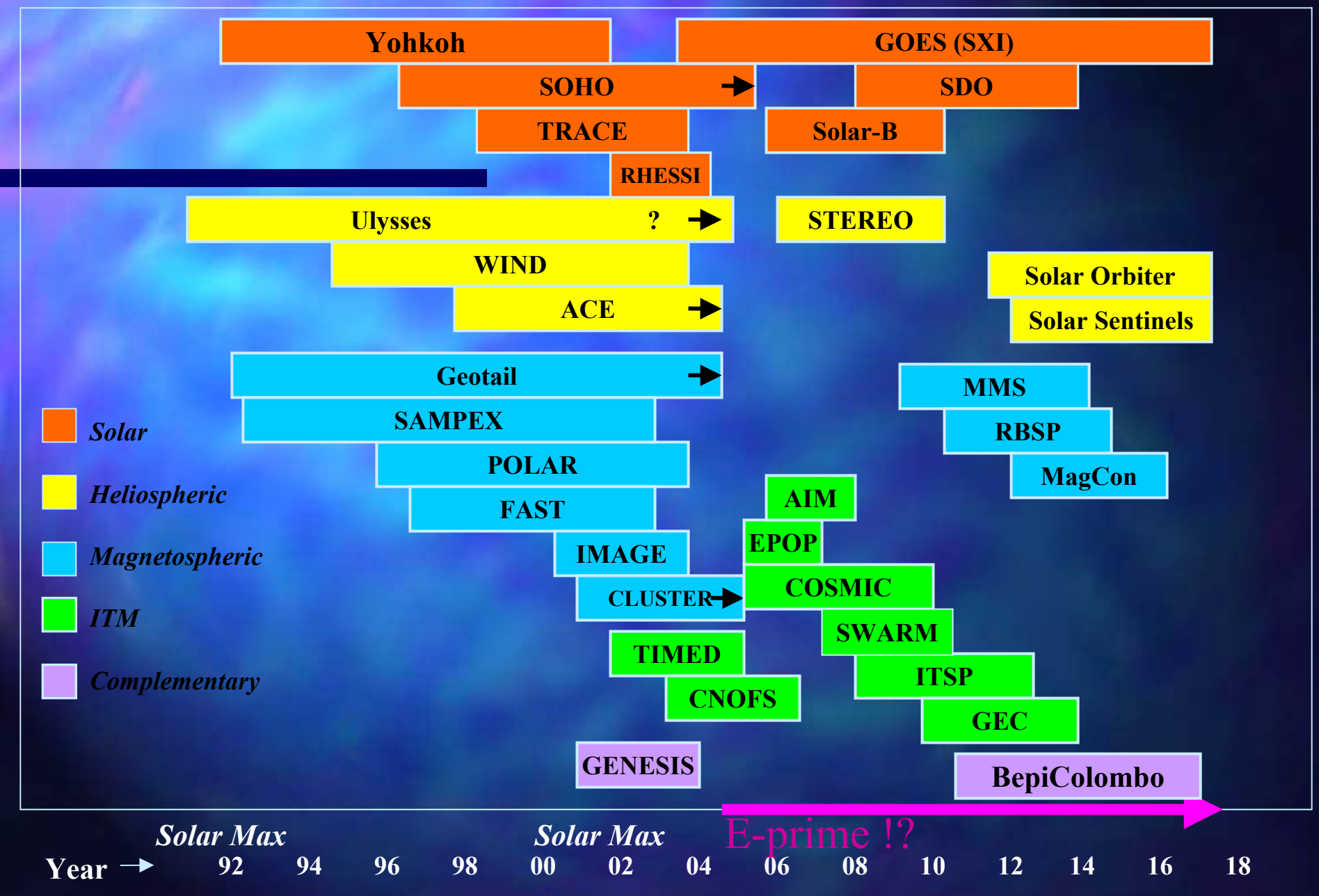
- Apply a systems approach.

1. Quantify the physics, dynamics, and development of the Sun-Earth connected system through the entire range of conditions occurring in the 11 year Solar cycle.
   - Obtain improved measurements in the entire Sun-Earth system
   - Aim at a better understanding of the causal chain in Sun-Earth disturbances.
   - Understand the cause and variability of the solar cycle.
     For long-range space weather forecasting & assessing solar role in climate change.
   - Determine space environmental conditions vs location & time in the solar cycle.
     Needed for design of systems to minimize sensitivity to space weather.
2. Develop predictive models for the system which
   - demonstrate our understanding of Solar and Near-Planetary Space Physics.
   - and allow a reasonably accurate forecast and quantification of space weather.
3. Minimize impact of space weather on technology and astronauts:
   - Apply improved space weather predictions and accurate space environmental design specifications.
   - Fly low cost flight test beds for validation of rad-hard, rad-tolerant systems.

International Living With A Star



Present Solar-STP Missions & "First Order" ILWS Mission Chart

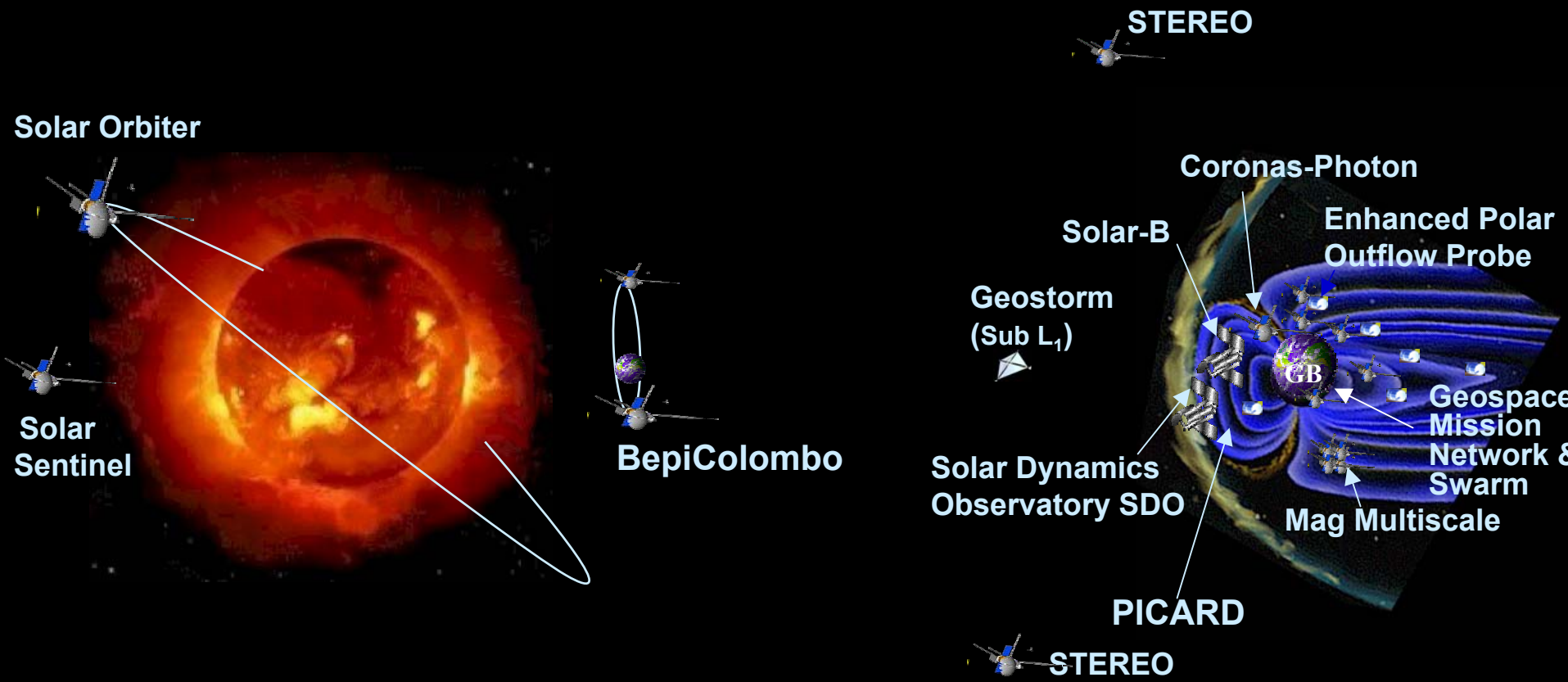


International Living With a Star

Some Candidate Missions

Ulysses

Distributed network of spacecraft providing observations of Sun-Earth system.



- *Solar-Heliospheric Network* **observing Sun & tracking disturbances from Sun to Earth.**
- *Geospace Mission Network* **with constellations of smallsats in key regions of geospace.**

Obvious Shortfalls in the Currently Planned ILWS Mission Fleet

- There is insufficient spacecraft coverage to sample simultaneously all critical regions & phenomena of the complex, time-varying geo-space environment
- The imaging of the upper terrestrial atmosphere and Earth's magnetosphere is severely limited in currently planned mission fleet (no UV, ENA etc imagers).
- Solar wind to be sampled at only a few points; no replacement for ACE (launched in 1997) at L1 in an approved (funded) program.
- Inadequate measurement of solar high energy phenomena (e.g. flares and energetic particles) currently planned for next solar maximum
- Gap in the measurement of Solar irradiance.